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# NOTES ON THE RATIOS OF INSECT FOOD HABITS.

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In the Ohio Journal of Science for March, 1924 (vol. xxiv, no. 2, pp. 100–106), the suggestion was made that in a large area embracing different types of vegetation, the ratios between the types of insect food habits vary but little if the numerical ratios between the species and the factors tending to reduce their numbers are considered as constant. Since this was written, the insects recorded from Connecticut (Bull. 31, State Geol. & Nat. Hist. Survey Conn.), were tabulated in accordance with their food habits and the results published in Entomological News (vol. xxxv, pp. 362–364, Dec., 1924) under the title "Ratios Between the Food Habits of Insects." The present paper is written for the purpose of presenting the results of the various tabulations in a more comparable form and should be considered as supplementary to the two papers mentioned above.

Table I shows the distribution ratios of the types of food habits present in three large areas, each area embracing different types of vegetation. These ratios are expressed as percentages of the total numbers of species listed in the left hand column, regardless of numerical abundance and are based on the predominating larval habits of the families. It will be noted that these percentages do not differ widely and that they suggest a fixed relation or at least a relation fluctuating within comparatively narrow limits. While assuming that the numbers of species listed from New Jersey and Connecticut are "complete counts," it is realized that numerous future additions in the parasitic Hymenoptera or more complete information about the food habits of many species would change the ratios but this would not affect what appears to be a fixed relation or natural order of things. Another factor which would change the ratios is the numerical abundance of the various species. As various species maintain

themselves in certain numerical ratios with respect to factors or combinations of factors tending to reduce their numbers and as these relationships are usually normal, such numerical ratios have been considered as constant in all of the tables.

TABLE I.

| | *No. species* | *Phytophagous* % | *Saprophagous* % | *Harpactophagous* % | *Parasitic* % | *Pollen feeders, misc. spp.* % |
|---|---|---|---|---|---|---|
| Western Arctic Coast of N. A. | 400 | 47 | 27 | 14 | 10 | 2 |
| State of New Jersey | 10,500 | 49 | 19 | 16 | 12 | 4 |
| State of Connecticut | 6,781 | 52 | 19 | 16 | 10 | 3 |
| Above areas combined | 17,681 | 50 | 19 | 16 | 11 | 4 |

TABLE II.

| | *No. species* | *Phytophagous* % | *Saprophagous* % | *Harpactophagous* % | *Parasitic* % | *Pollen feeders, misc. spp.* % |
|---|---|---|---|---|---|---|
| Moist woods on Piedmont Plain of N. J. | 415 | 37 | 35 | 20 | 5 | 3 |
| A thicket on Piedmont Plain of N. J. | 273 | 63 | 9 | 19 | 7 | 2 |
| Dry woods in "pine barrens" of N. J. | 381 | 45 | 21 | 18 | 14 | 2 |
| Open area in "pine barrens" of N. J. | 246 | 41 | 10 | 24 | 18 | 7 |
| Salt marsh on coast of N. J. | 210 | 39 | 21 | 26 | 13 | 1 |
| Above areas combined | 1,525 | 45 | 21 | 21 | 10 | 3 |

In table II the distribution ratios are shown for various areas in New Jersey, the vegetation in each area being more or less uniform and each area being relatively small in comparison with the areas listed in table I. The figures in table II show more variation or dispersion than those in table I and appear to indicate that the ratios between the various types of food habits vary in accordance with the vegetation when small areas, each with a uniform type of vegetation, are considered.

In table III will be found comparisons, using the parasitic food habit as a base. For example, if the parasitic food habit in the state of New Jersey is represented by 1, the relative importance of the other types will be, harpactophagous, 1.3; saprophagous, 1.6; phytophagous, 4.1, etc.

TABLE III.

| | *No. species* | *Phyto-phagous* | *Sapro-phagous* | *Harpacto-phagous* | *Para-sitic* | *Pollen feeders, misc. spp.* |
|---|---|---|---|---|---|---|
| Western Arctic Coast of N. A. | 400 | 4.7 | 2.7 | 1.4 | 1.0 | 0.20 |
| State of N. J. | 10,500 | 4.1 | 1.6 | 1.3 | 1.0 | 0.33 |
| State of Conn. | 6,781 | 5.2 | 1.9 | 1.6 | 1.0 | 0.30 |
| Above areas combined | 17,681 | 4.5 | 1.7 | 1.4 | 1.0 | 0.36 |
| Moist woods on Piedmont Plain of N. J. | 415 | 7.4 | 7.0 | 4.0 | 1.0 | 0.6 |
| A thicket on Piedmont Plain of N. J. | 273 | 9.0 | 1.3 | 2.7 | 1.0 | 0.3 |
| Dry woods in "pine barrens" of N. J. | 381 | 3.2 | 1.5 | 1.3 | 1.0 | 0.1 |
| Open area in "pine barrens" of N. J. | 246 | 2.3 | 0.5 | 1.3 | 1.0 | 0.4 |
| Salt marsh on coast of N. J. | 210 | 3.0 | 1.6 | 2.0 | 1.0 | 0.07 |
| All New Jersey areas combined | 1,525 | 4.5 | 2.1 | 2.1 | 1.0 | 0.3 |

Table IV shows the variation of the percentages in tables I and II by means of coefficients of variation. For example, the dispersion or variation among the items 47, 49 and 52, the phytophagous series in table I is much less than in the pollen series 2, 4, 3 and the coefficient of varia-

tion for each food habit group affords a simple means of comparison. If the variations in a series are large then the coefficient is large and *vice versa*. The coefficient of variation was arrived at by dividing the standard deviation by the arithmetic means of the series and the standard deviation was secured by squaring each item in a series; adding the squared items and dividing by the number of items; subtracting from the quotient the square of the arithmetic average of the series and extracting the square root of the difference. Although a more refined method designed to take into consideration the "true averages" shown at the bottoms of tables I and II could have been used, the "true averages" are close to the arithmetic averages. The coefficient of variation is used not to give a fictitious accuracy to the subject but solely to reduce the different series to a comparable basis.

TABLE IV

COEFFICIENTS OF VARIATION.

| | *Phytophagous* | *Saprophagous* | *Harpactophagous* | *Parasitic* | *Pollen feeders, misc. spp.* |
|---|---|---|---|---|---|
| New Jersey areas | 0.208 | 0.491 | 0.143 | 0.417 | 0.699 |
| Other areas | 0.055 | 0.191 | 0.090 | 0.095 | 0.270 |

According to the above table, the variation in each series of food habits is much greater for the different areas in New Jersey than for the other areas, i. e., the entire state of New Jersey, the entire state of Connecticut and the western Arctic coast of North America. This taken into consideration with the figures shown in table I appears to indicate that the ratios between the various types of food habits based on the species present vary but little when large areas each embodying different types of vegetation are considered *in toto* and when the numerical ratios between the species present and the factors tending to reduce their numbers are considered as constant; also that in relatively small areas each with a uniform type of vegetation, the ratios between the types of food habits, based on the species present, vary in accordance with the type of vegetation if the numerical ratios between the species and the factors tending to reduce their numbers are considered as constant. It should be understood that these conclusions do not apply to areas under cultivation but to such as are relatively unchanged by man.